

What is claimed is:

1. An apparatus to perform semiconductor processing, comprising:

a process chamber;

a plasma generator for generating a plasma in the process chamber; and

5 a helical ribbon electrode coupled to the output of the plasma generator.

2. The apparatus of claim 1, wherein the helical ribbon electrode is external to the process chamber.

3. The apparatus of claim 2, further comprising a dielectric wall position
10 between the chamber and the helical ribbon electrode.

4. The apparatus of claim 3, wherein the dielectric wall is a flat plate.

5. The apparatus of claim 3, wherein the dielectric wall is concave.

6. The apparatus of claim 3, wherein the dielectric wall is convex.

7. The apparatus of claim 3, wherein the dielectric wall is a tube.

15 8. The apparatus of claim 7, wherein the dielectric wall projects through the center of the helical ribbon electrode.

9. The apparatus of claim 1, wherein the helical ribbon electrode is internal to the process chamber.

10. The apparatus of claim 1, wherein the apparatus is adapted to receive a
20 workpiece in the chamber and wherein the distance between the helical ribbon electrode and the workpiece is less than five inches.

11. The apparatus of claim 1, wherein the apparatus is adapted to receive a workpiece in the chamber and wherein the distance between the helical ribbon electrode and the workpiece is between approximately one inch and approximately three inches.

12. The apparatus of claim 1, wherein the plasma generator pulses the helical ribbon electrode to perform pulse processing.

13. The apparatus of claim 1, further comprising a controller coupled to the control input of the plasma generator to control the generation of the plasma.

14. The apparatus of claim 1, wherein the plasma generator is a radio frequency (RF) plasma generator.

15. The apparatus of claim 1, wherein the plasma generator is a solid state plasma generator without any moving parts and capable of short tuning response time.

16. The apparatus of claim 1, wherein the plasma generator is a solid state plasma generator employing frequency tuning to achieve output matching.

17. A method to deposit a multi-layer semiconductor, comprising:
(a) introducing a gas into a processing chamber; and
(b) generating a pulse with a response time of less than one second; and
(c) exciting the plasma in accordance with the pulse using a helical ribbon electrode.

18. The method of claim 17, further comprising purging the chamber.

19. The method of claim 17, further comprising sequentially pulsing the plasma for each layer to be deposited.

20. A multi-layer processing chamber, comprising:

5 a gas source coupled to the chamber for introducing a processing gas into a reaction chamber having a sample disposed therein;

a solid state RF plasma source coupled to the chamber to excite the processing gas;

a helical ribbon electrode adapted to excite the plasma; and

10 a controller coupled to the solid state RF plasma source to pulse the solid state RF plasma source for each deposited layer.